

<IGBT Modules>

CM1200DW-40T

**HIGH POWER SWITCHING USE
INSULATED TYPE**



Collector current I_c **1 2 0 0 A**
 Collector-emitter voltage V_{CES} **2 0 0 0 V**
 Maximum junction temperature T_{vjmax} **1 7 5 °C**

- Dual switch (Half-bridge)
- Copper base plate (Nickel-plating)
- Ni-plating signal terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No.E323585

APPLICATION

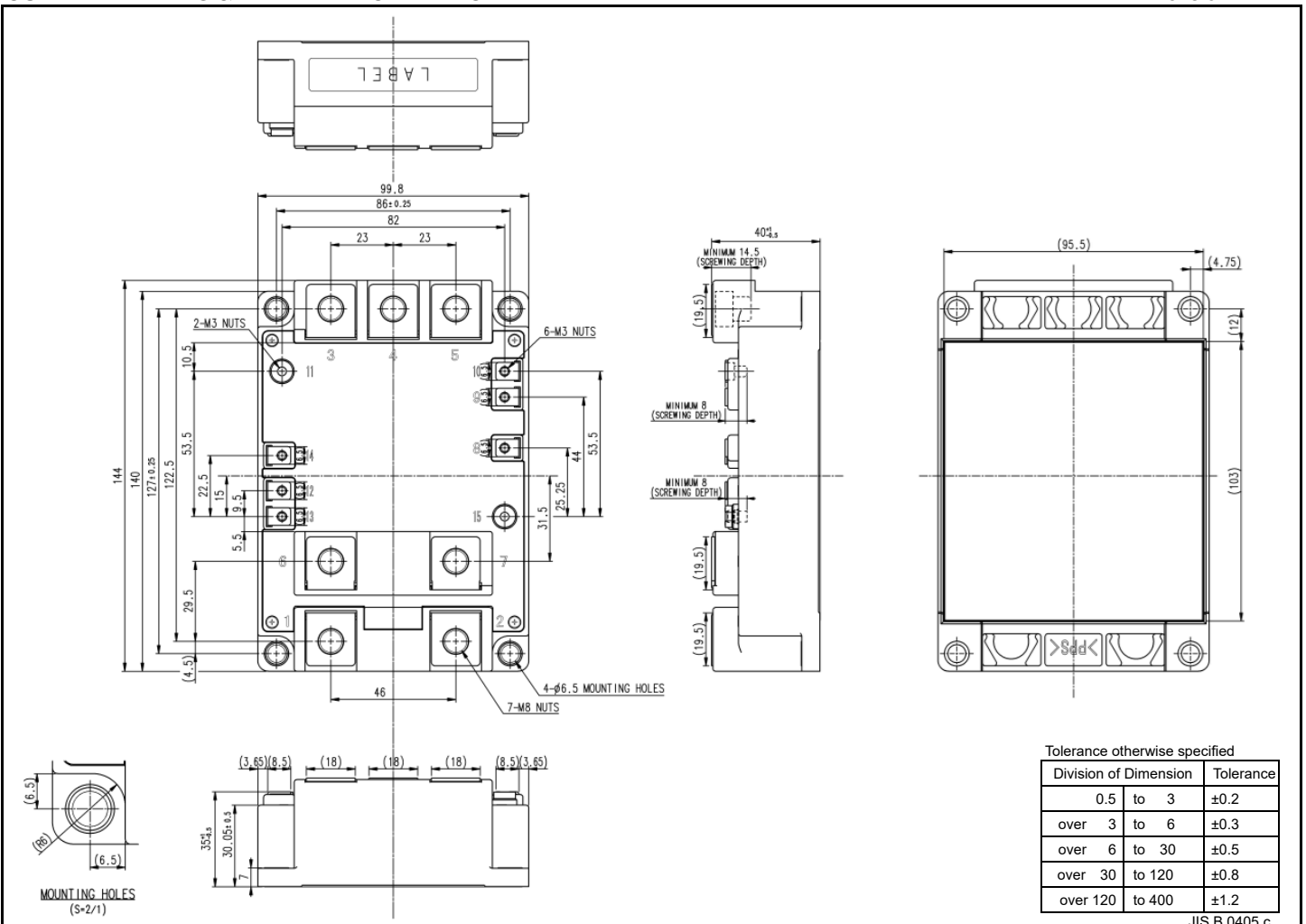
Photovoltaic power converter, Energy storage system, Wind power converter, etc.

OPTION

- V_{CESat} selection for parallel connection
- PC-TIM (Phase Change Thermal Interface Material) pre-apply

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm

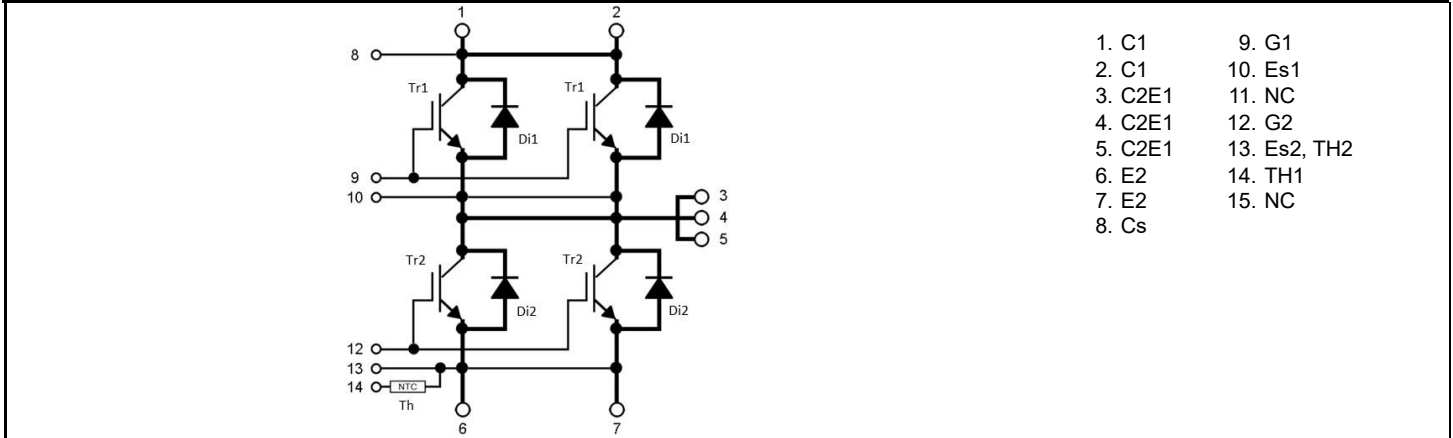


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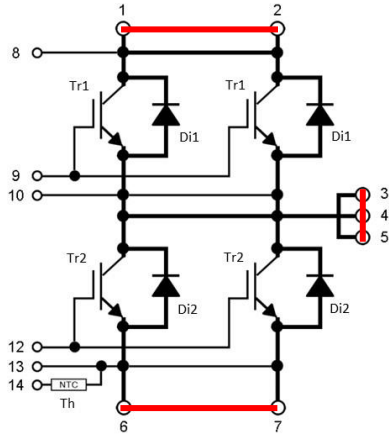
INTERNAL CONNECTION

TERMINAL CODE



NOTE

Terminal 1 and 2, Terminal 3,4 and 5, Terminal 6 and 7,
These terminals should be connected respectively when it is used.



CM1200DW-40THIGH POWER SWITCHING USE
INSULATED TYPE**MAXIMUM RATINGS (T_{vj}=25 °C, unless otherwise specified)**

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	2000	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =77 °C (Note2, 4)	1200	A
I _{CRM}		Pulse, Repetitive (Note3)	2400	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	5555	W
I _E (Note1)	Emitter current	DC (Note2)	1200	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	2400	
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60Hz, AC 1min	4000	V
T _{vj max}	Maximum junction temperature	Instantaneous event (overload) (Note9)	175	°C
T _{C max}	Maximum case temperature	(Note4,9)	125	°C
T _{vj op}	Operating junction temperature	Continuous operation (Note9)	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS (T_{vj}=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I _{CES}	Collector-emitter cut-off current	V _{CE} =V _{CES} , G-E short-circuited	-	-	1.0	mA	
I _{GES}	Gate-emitter leakage current	V _{GE} =V _{GES} , C-E short-circuited	-	-	0.5	μA	
V _{GE(th)}	Gate-emitter threshold voltage	I _C =120 mA, V _{CE} =10 V	5.5	6.0	6.6	V	
V _{CESat}	Collector-emitter saturation voltage	I _C =1200 A (Note5) V _{GE} =15 V, (Terminal)	T _{vj} =25 °C	-	2.15	2.50	V
			T _{vj} =125 °C	-	2.55	-	
			T _{vj} =150 °C	-	2.65	-	
		I _C =1200 A (Note5) V _{GE} =15 V, (Chip)	T _{vj} =25 °C	-	2.10	2.35	V
			T _{vj} =125 °C	-	2.50	-	
			T _{vj} =150 °C	-	2.60	-	
C _{ies}	Input capacitance	V _{CE} =10 V, V _{GE} =0V	-	-	330	nF	
C _{oes}	Output capacitance		-	-	5.7		
C _{res}	Reverse transfer capacitance		-	-	2.4		
Q _G	Gate charge	V _{CC} =1300 V, I _C =1200 A, V _{GE} =15 V	-	9.5	-	μC	
t _{d(on)}	Turn-on delay time	V _{CC} =1300 V, I _E =1200 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	900	ns	
t _r	Rise time		-	-	160		
t _{d(off)}	Turn-off delay time		-	-	900		
t _f	Fall time		-	-	1250		
V _{EC} (Note1)	Emitter-collector voltage	I _E =1200 A (Note5) G-E short-circuited (Terminal)	T _{vj} =25 °C	-	2.25	3.20	V
			T _{vj} =125 °C	-	2.60	-	
			T _{vj} =150 °C	-	2.60	-	
		I _E =1200 A (Note5), G-E short-circuited, (Chip)	T _{vj} =25 °C	-	2.20	2.95	V
			T _{vj} =125 °C	-	2.55	-	
			T _{vj} =150 °C	-	2.55	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =1300 V, I _E =1200 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	900	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	340	-	μC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =1300V, I _C =I _E =1200A, V _{GE} =±15V, R _G =0Ω, T _{vj} =150°C, Inductive load	-	270	-	mJ	
E _{off}	Turn-off switching energy per pulse		-	580	-		
E _{rr} (Note1)	Reverse recovery energy per pulse		-	430	-		
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip T _C =25°C (Note4)	-	0.25	-	mΩ	
r _g	Internal gate resistance	Per switch	-	0.63	-	Ω	

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NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R ₂₅	Zero-power resistance	T _C =25 °C (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R ₁₀₀ =493 Ω, T _C =100 °C (Note4)	-7.3	-	+7.8	%
B _(25/50)	B-constant	Approximate by equation (Note6)	-	3375	-	K
P ₂₅	Power dissipation	T _C =25 °C (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance	Junction to case, per IGBT switch (Note4)	-	-	27	K/kW
R _{th(j-c)D}		Junction to case, per FWD switch (Note4)	-	-	44	
R _{th(c-s)}	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7, 9)	-	10	-	K/kW

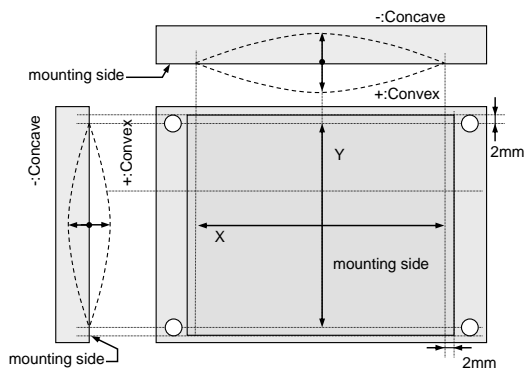
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M _t	Mounting torque	Main terminals M 8 screw	7.0	10.5	14.0	N·m
M _s		Mounting to heat sink M 6 screw	3.5	4.0	4.5	
M _t		Auxiliary terminals M 3 screw	0.4	0.5	0.6	
d _s	Creepage distance	Terminal to terminal	17	-	-	mm
		Terminal to base plate	30	-	-	
d _a	Clearance	Terminal to terminal	8.5	-	-	mm
		Terminal to vase plate	28	-	-	
e _c	Flatness of base plate	On the centerline X, Y (Note8)	0	-	+200	μm
m	mass	-	-	860	-	g

*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU and (EU)2015/863.

Note 1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

- Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
- Case temperature (T_C) and heat sink temperature (T_S) are defined on the each surface (mounting side) of base plate and heat sink just under the chips. Refer to the figure of chip location.
- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
- $B(25/50) - \ln \left(\frac{R_{25}}{R_{50}} \right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$
 R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅=25 [°C]+273.15=298.15 [K]
 R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀=50 [°C]+273.15=323.15 [K]
- Reference value. Thermally conductive grease of thermal conductivity λ=0.9 W/(m·K) and thickness D_(c-s)=50 μm.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



- Long term performance related to thermal conductive grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under user's specific application conditions. Each temperature condition (T_{vjmax}, T_{vjop}, T_{Cmax}) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	1300	1500	V	
V_{GEon}	Gate-emitter drive voltage	Applied across G1-Es1/G2-Es2 terminals	13.5	15.0	16.5	V	
R_G	External gate resistance	Per switch	on	0	-	6.8	Ω
			off	0	-	15	Ω

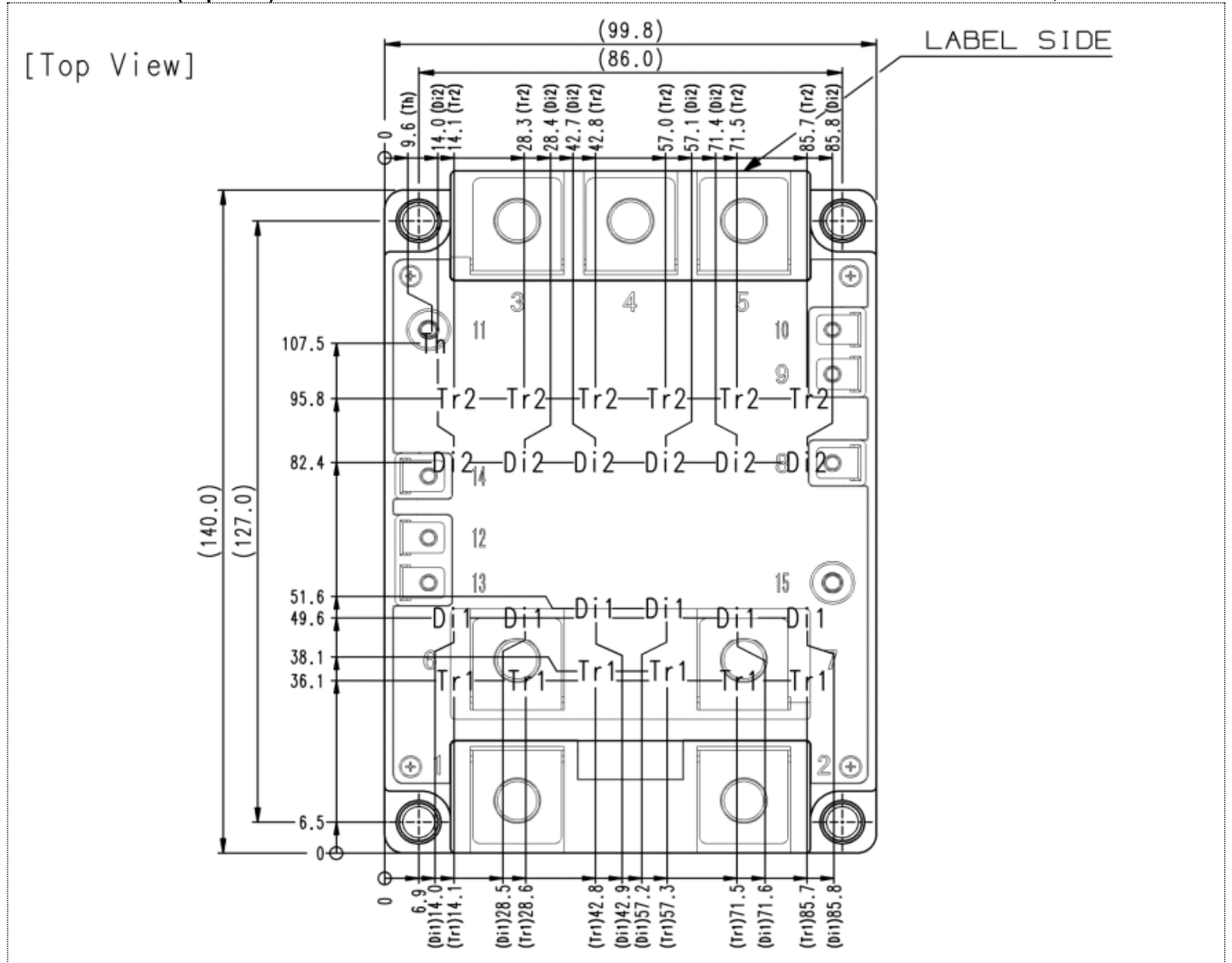
Optimum operating conditions should be selected with careful confirmation for no occurrence of any maximum rating violation (T_{vj} , V_{CES} , etc.) or any unexpected malfunction (arm-short-through, oscillation, etc.) at the actual application conditions.

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HIGH POWER SWITCHING USE
INSULATED TYPE

CHIP LOCATION (Top view)

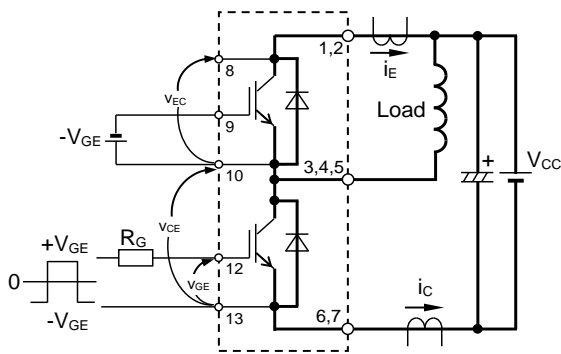
Dimension in mm, tolerance: ±1 mm



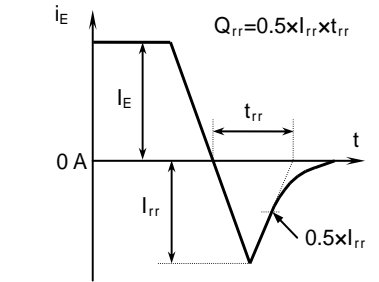
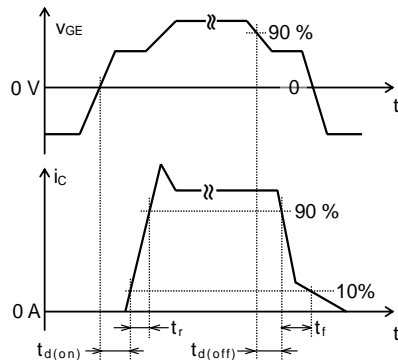
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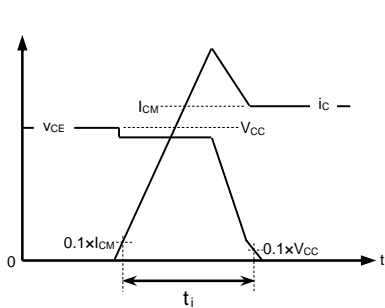
TEST CIRCUIT AND WAVEFORMS



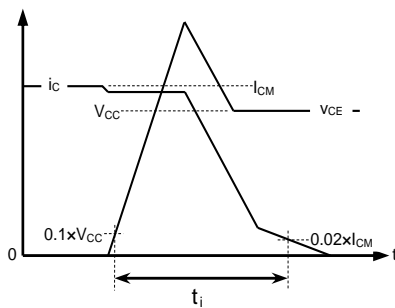
Switching characteristics test circuit and waveforms



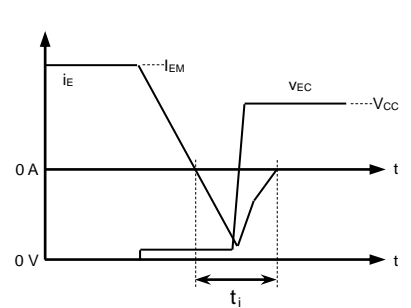
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



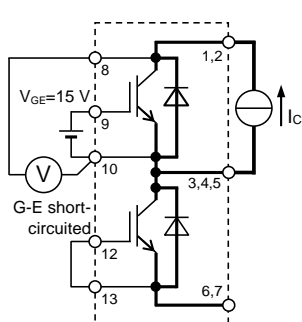
IGBT Turn-off switching energy



FWD Reverse recovery energy

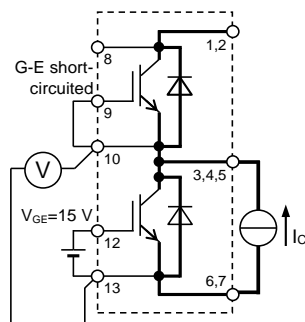
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

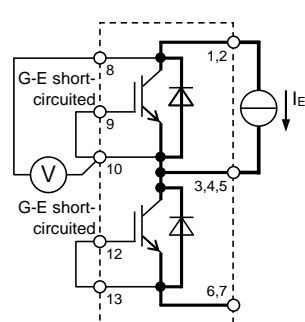


Tr1

V_{CEsat} characteristics test circuit

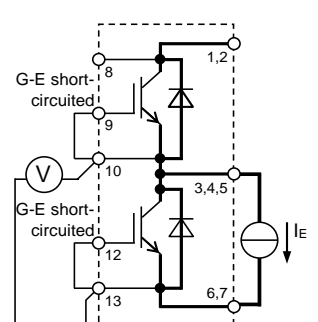


Tr2



Di1

V_{CE} characteristics test circuit



Di2

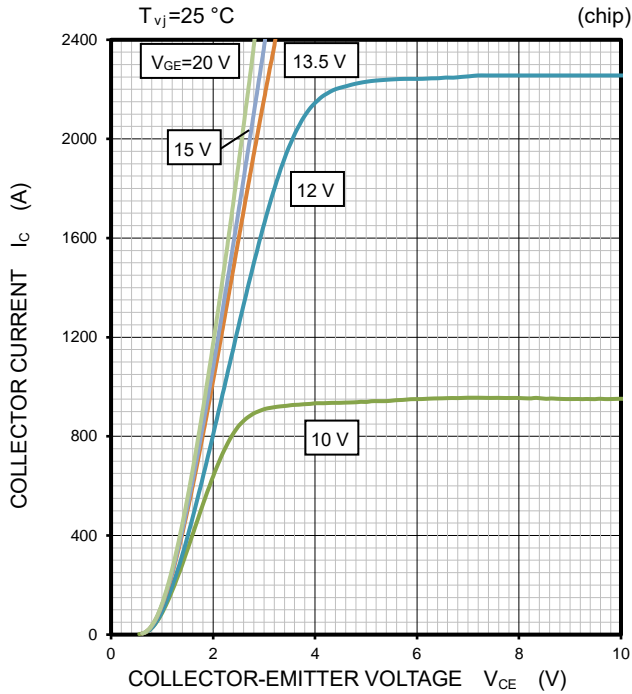
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HIGH POWER SWITCHING USE
INSULATED TYPE

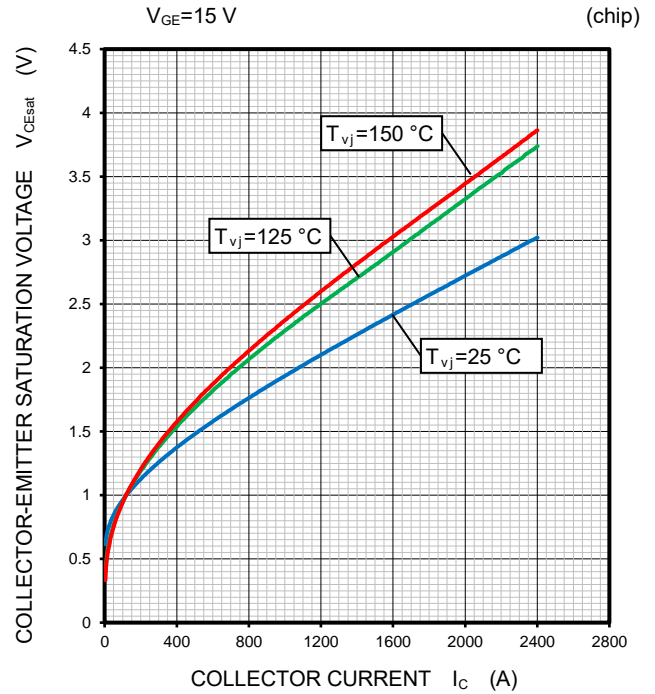
PERFORMANCE CURVES

INVERTER PART

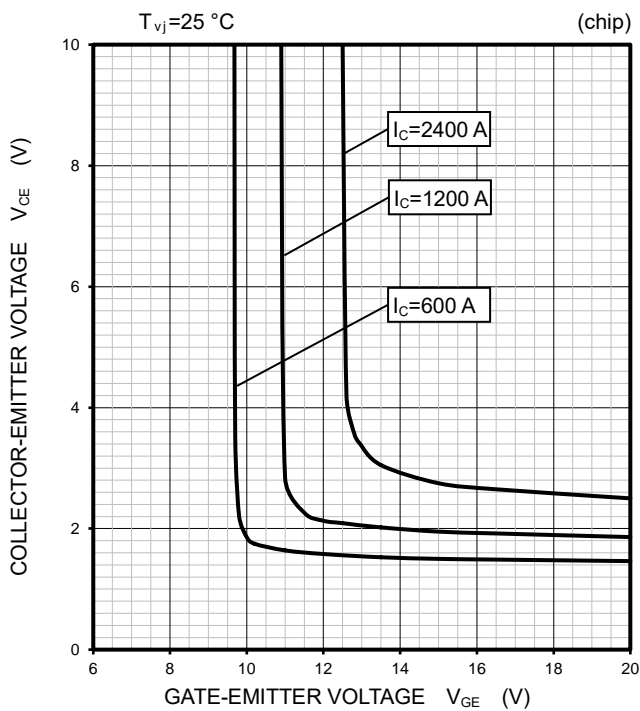
OUTPUT CHARACTERISTICS (TYPICAL)



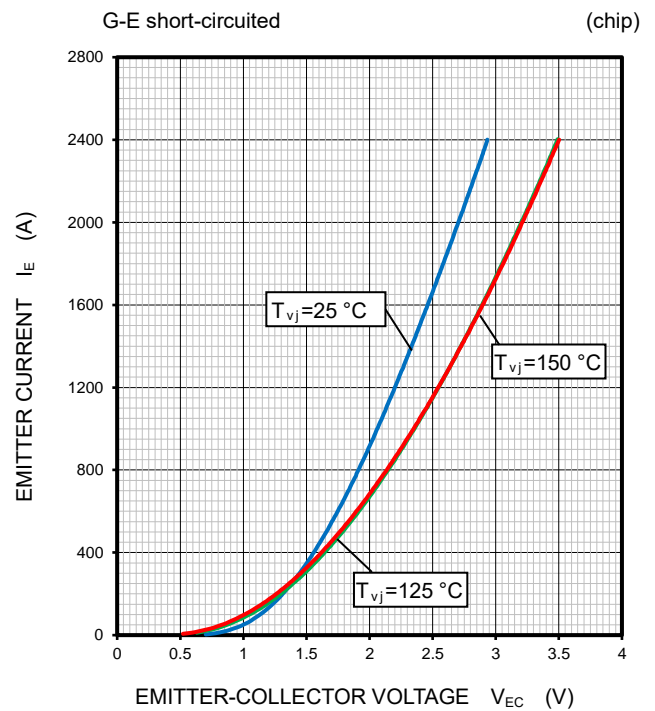
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



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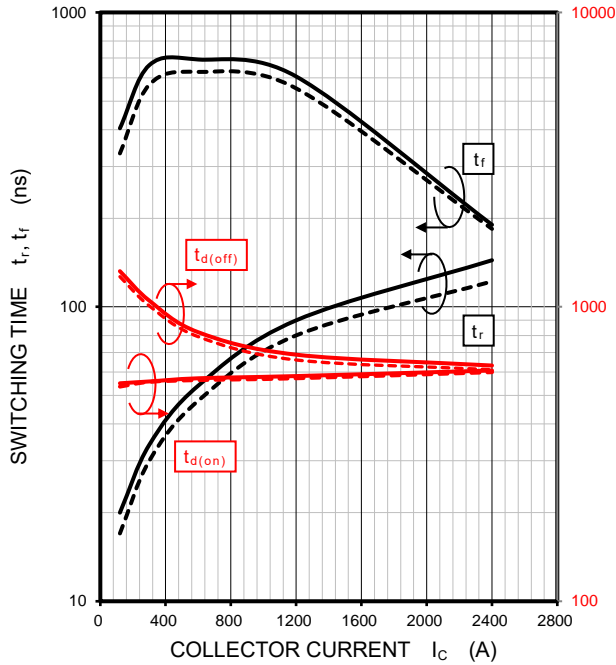
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

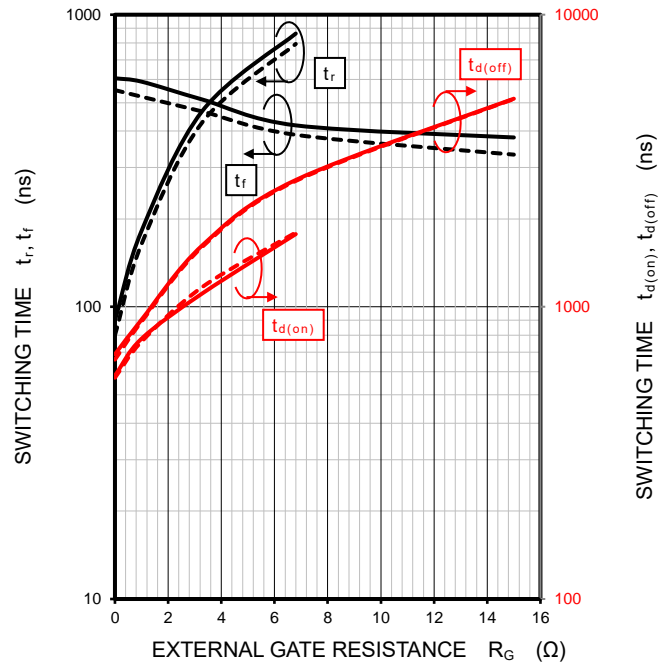
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300\text{ V}$, $R_G=0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



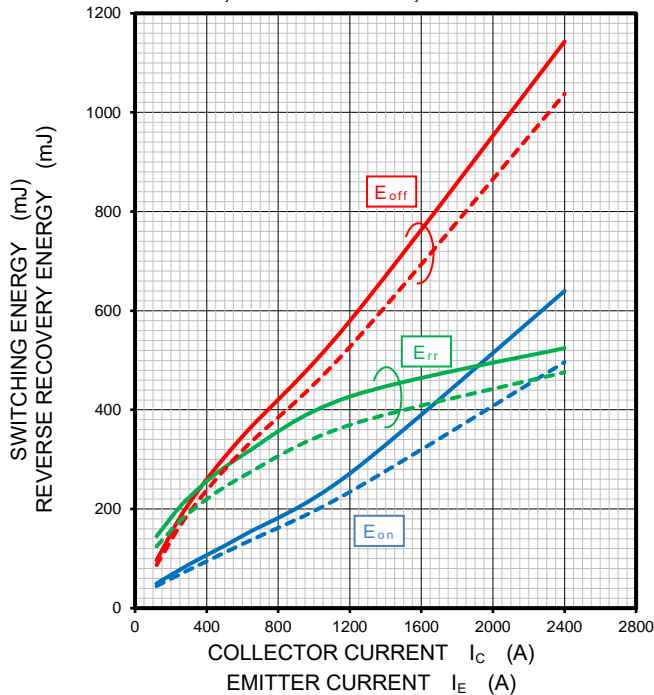
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300\text{ V}$, $I_C=1200\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



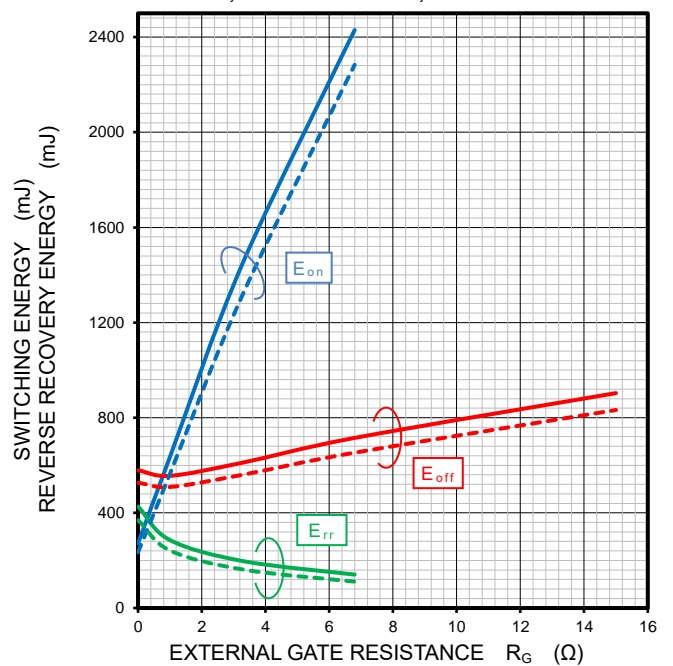
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300\text{ V}$, $R_G=0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD, PER PULSE
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300\text{ V}$, $I_C/I_E=1200\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD, PER PULSE
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



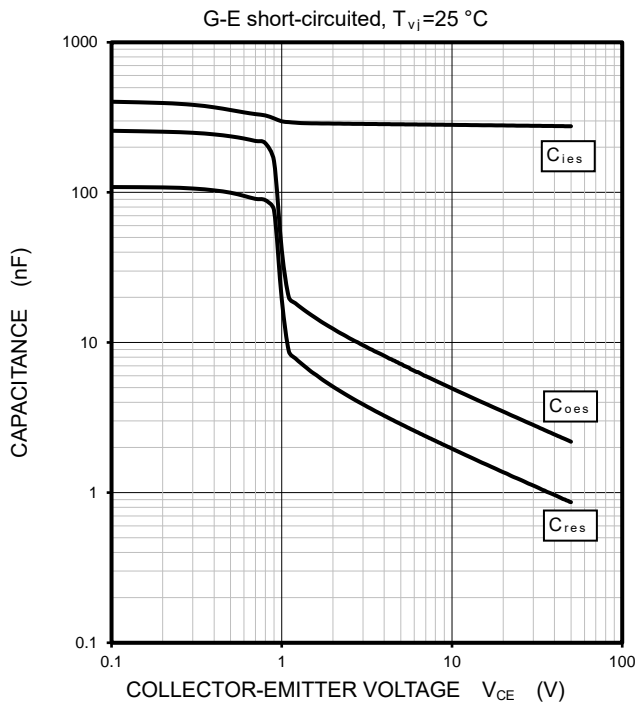
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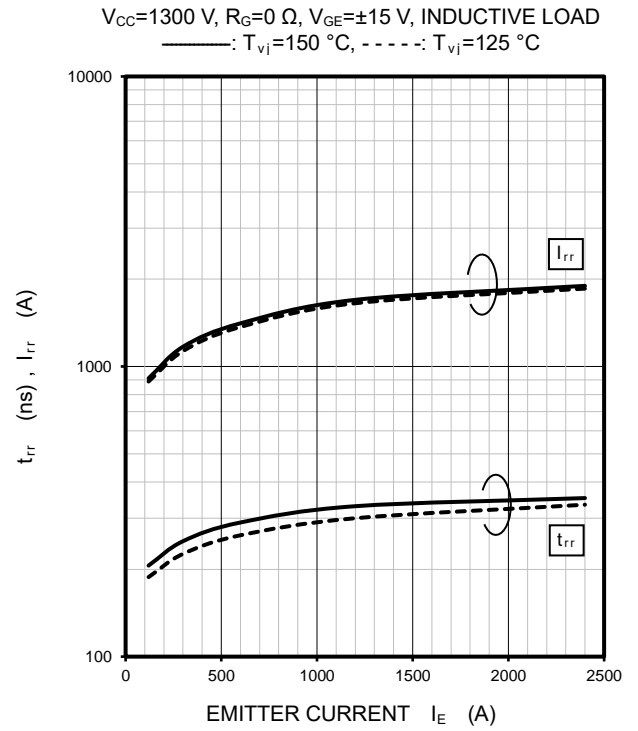
PERFORMANCE CURVES

INVERTER PART

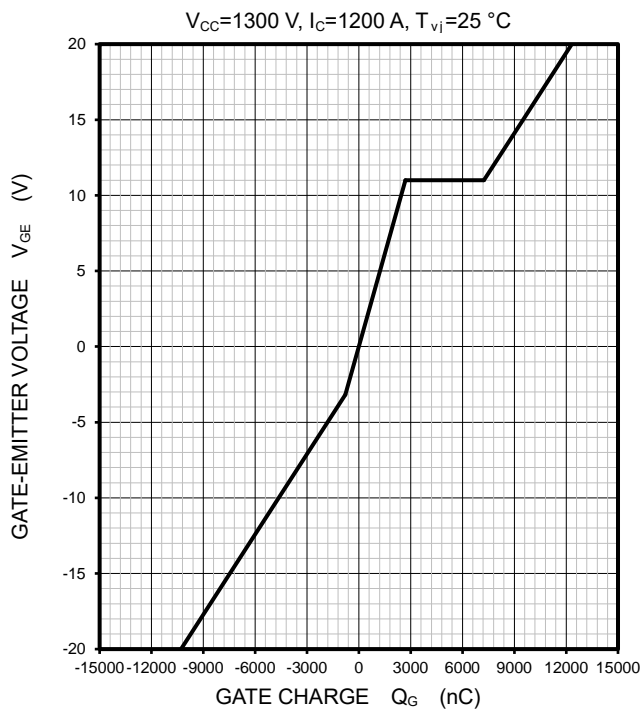
CAPACITANCE CHARACTERISTICS (TYPICAL)



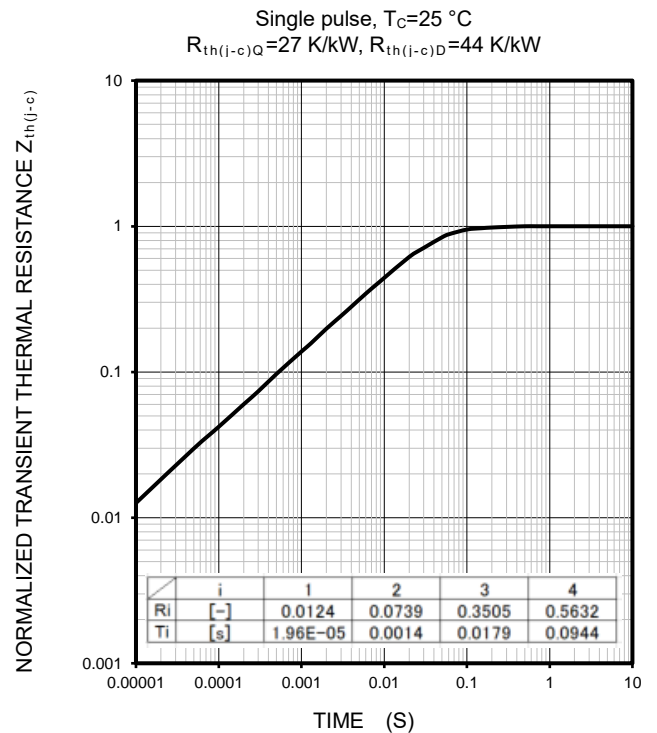
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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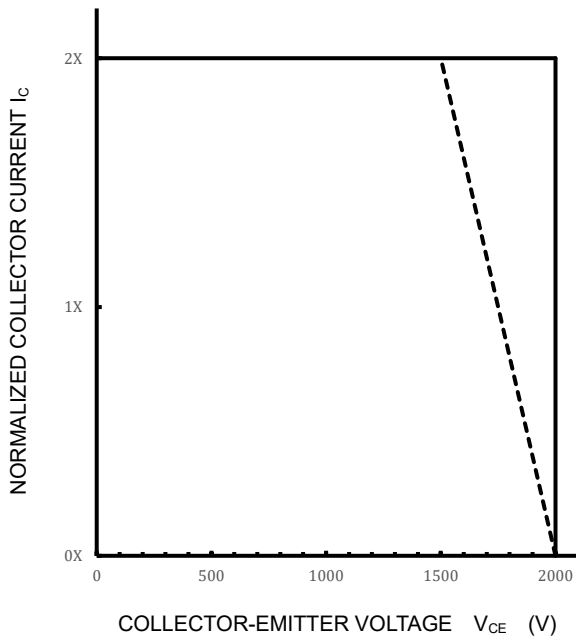
HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

INVERTER PART

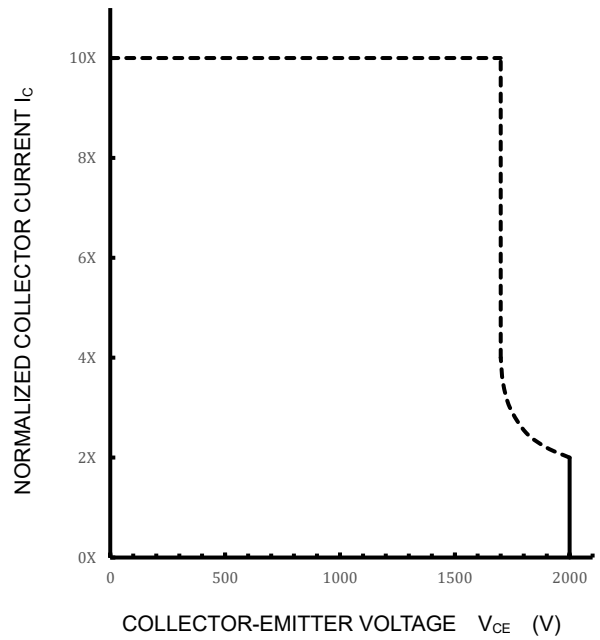
TURN-OFF SWITCHING SAFE OPERATING AREA (REVERSE BIAS SAFE OPERATING AREA) (MAXIMUM)

$V_{CC} \leq 1500 \text{ V}$, $R_{G(OFF)} = 0 \sim 15 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 ———: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
 - - - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))



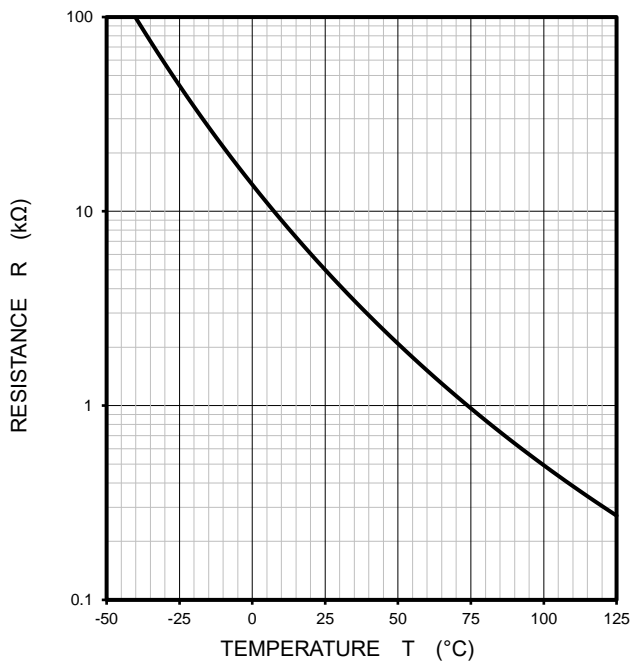
SHORT-CIRCUIT SAFE OPERATING AREA (MAXIMUM)

$V_{CC} \leq 1500 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_w \leq 6 \ \mu\text{s}$, Non-Repetitive



NTC thermistor part

TEMPERATURE CHARACTERISTICS (TYPICAL)



Note: The characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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Important Notice

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Keep safety first in your circuit designs!

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